BASEBAND PROCESSING METHOD FOR RECEIVED SIGNAL, AND BASE STATION

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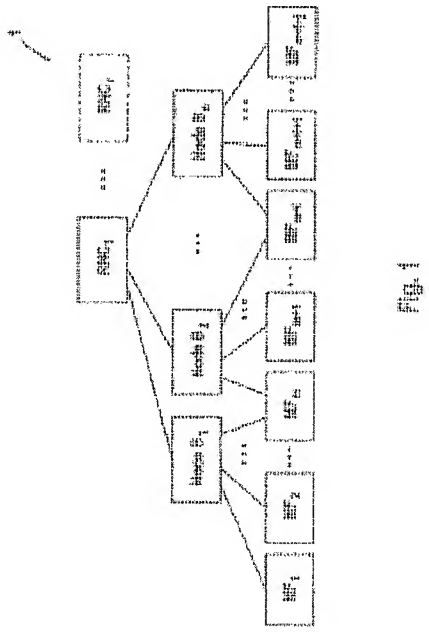
Abstract of **JP 2002319920 (A)**

PROBLEM TO BE SOLVED: To provide a baseband processing method for a received signal 2 in at least one baseband unit 4 of a base station Node B of a wireless remote communication system 1, in which one or each of all baseband units 4 has at least one calculation element, in details, has a microprocessor. SOLUTION: In the base station Node B, hardware can be eliminated on one hand and suitable calculation throughput can be utilized on the other hand. Therefore, even concerning the received signal 2 of adverse quality, in order to execute baseband processing for making sure processing with a specified quality within a specified period, corresponding to the utilization rate of the calculation element 8 of the baseband unit 4, baseband processing is assigned to at least one specified calculation element 8 of at least one baseband unit 4.



1. Abstract

The invention concerns a process for baseband processing of received signals (2) in at least one baseband unit (4) of a base station (Node B) of a radio telecommunications system (1), wherein the baseband unit (4) or every baseband unit (4) has at least one computing element (8), in particular a microprocessor. In order to realise baseband processing in the base station (Node B), in which, on the one hand, hardware can be eliminated and, on the other hand, an adequate computing capacity is available so that, even for received signals (2) of poor quality, processing can be ensured within a specified time period and with a specified quality, it is proposed that the baseband processing is assigned to at least one specific computing element (8) of at least one baseband unit (4) according to the utilisation of the computing elements (8) of the baseband units (4).

2. Representative Drawing

Fig. 1

【外国語明細書】

1. Title of Invention

Process and base station for baseband processing of received signals

2. Claims

1. Process for baseband processing of received signals in at least one baseband unit of a base station of a radio telecommunications system, wherein the baseband unit or every baseband unit has at least one computing element, in particular a microprocessor, wherein the baseband processing is assigned to at least one specific computing element of at least one baseband unit according to the utilisation of the computing elements of the baseband units.

2. Process according to Claim 1, wherein the baseband processing is assigned to at least one specific computing element of at least one specific baseband unit, and that the baseband processing within the baseband unit is assigned, at least partially, to at least one further computing element of the baseband unit.

3. Process according to Claim 1, wherein the baseband processing is assigned to at least one specific computing element of at least one specific baseband unit, and that the baseband processing is assigned, at least partially, to at least one computing element of at least one further baseband unit.

4. Process according to one of Claims 1 to 3, wherein the received signals are transmitted via several channels, wherein at least one channel is assigned to each computing element, and that the baseband processing of a channel is assigned, at least partially, to a further computing element, if the available computing capacity of the at least one computing element assigned to the channel is inadequate.

5. Process according to Claim 4, wherein the expected utilisation of the at least one computing element assigned to the channel is estimated prior to the start of the baseband processing.

6. Process according to Claim 4 or 5, wherein the utilisation of the at least one computing element assigned to the channel is monitored during the baseband processing.

7. Base station of a radio telecommunications system, containing at least one high-frequency unit for processing analogue signals and several baseband units for processing digital signals, wherein each of the baseband units has at least one computing element, in particular a microprocessor, said base station having first means for determining the utilisation of the computing elements of the baseband units and second means for assigning received signals waiting for baseband processing to at least one computing element of at least one baseband unit, wherein the assignment is implemented according to the utilisation of the computing elements.

8. Base station according to Claim 7, said the computing elements of the baseband units being interconnected via high-speed interfaces.

9. Base station according to Claim 7 or 8, said the second means being designed as a watchdog unit which pass the received signals waiting for baseband processing to a memory area of at least one computing element of at least one baseband unit.

10. Radio telecommunications system containing a number of mobile radio units, several base stations, that are in radio contact with the mobile radio units, and at least one control device for controlling the radio telecommunications system, which control device is linked to the base stations, said at least one of the base stations being designed according to one of Claims 7 to 9.

3. Detailed Description of Invention

Background of the invention

The present invention concerns a process for baseband processing of received signals in at least one baseband unit of a base station of a radio telecommunications system. The baseband unit or every baseband unit has at least one computing element, in particular a microprocessor.

The invention is based on a priority application DE 101 15 610.3 which is hereby incorporated by reference.

The invention also concerns a base station of a radio telecommunications system, containing at least one high-frequency (HF) unit for processing analogue signals and several baseband units for processing digital signals. Each of the baseband units has at least one computing element, in particular a microprocessor.

Finally, the present invention concerns a radio telecommunications system containing a number of mobile radio units, several base stations that are in radio contact with the mobile radio units, and at least one control device for controlling the radio telecommunications system, which is linked to the base stations.

Summary of the invention

A radio telecommunications system with base stations of the type stated at the outset is, for example, known from the prior art as a so-called universal mobile telecommunications system (UMTS). In UMTS

telecommunications systems, the base stations are described as Node B and the control devices as radio network controllers (RNC). In a so-called uplink mode, data are transmitted from the mobile radio units to the base station via a radio link. The data from various radio units are modulated according to the so-called code division multiple access (CDMA) process and transmitted via a common channel. Several channels are combined into one radio signal, which is received as a received signal in those base stations with which the radio units are in radio contact. The received signals are processed in the base stations.

The processing of the received signals in the base stations is carried out separately for analogue and for digital signals. While the analogue signals are processed in so-called high-frequency (HF) units, the digital signals are processed in so-called baseband units. In the case of signals modulated according to the CDMA process, the digital processing in the baseband units contains, among other things, so-called symbol rate processing and so-called chip rate processing. Chip rate processing is employed to recover the individual channels from the received signal. Symbol rate processing is employed on an individual channel in order to recover the transmitted data of the individual radio units from the signal transmitted via the channel.

The base stations receive signals via different channels. According to the prior art, for the processing of the analogue and digital signals, a specified reference is provided in a base station between a channel and the HF units or the baseband units, respectively, which process the signals of this channel. However, this specified reference requires a substantially constant effort for the baseband processing. In modern radio telecommunications systems in particular, such as for example UMTS

telecommunications systems, the baseband processing effort, in particular for chip rate processing, as used in a so-called rake receiver, for example, is not constant, but depends on the quality of the received signal, that is to say on the number of fingers of a rake receiver, that are required for the reception of a signal of a specific quality. The computing capacity required for the baseband processing for the received signals of a channel can therefore vary very widely. In order to always have sufficient computing capacity, it is necessary to design this to be relatively large to be able to ensure processing of the received signal within a specified time and with a specified quality, even in the worst case. On average, however, large parts of this available computing capacity are not needed since the quality of the received signal is usually better than the worst case.

The object of the present invention is therefore to realise, in base stations of radio telecommunications systems, baseband processing in which, on the one hand, hardware can be eliminated in the base station and, on the other hand, an adequate computing capacity is available so that, even for received signals of poor quality, processing can be ensured within a specified time period and with a specified quality.

To achieve this object, based on the process of the type stated at the outset, it is proposed that the baseband processing is assigned to at least one specific computing element of at least one baseband unit according to the utilisation of the computing elements of the baseband units.

According to the invention, it is therefore proposed to first determine the utilisation of the individual computing elements of the baseband units. Depending on the

utilisation of the computing elements, the baseband processing of a received signal waiting to be processed is then assigned to at least one specific computing element of at least one baseband unit. According to the present invention, it is possible to assign the entire baseband processing to one computing element of a baseband unit that has the required available computing capacity. However, it is also conceivable to share the baseband processing with several computing elements of one or more baseband units which, as a whole, can then make available the required computing capacity. The crux of the present invention is therefore to replace the rigid assignment between HF units and baseband units known from the prior art, by a utilisation-related adaptive assignment.

The more hardware that can be eliminated in a base station, then the more uniformly the baseband processing can be distributed among all computing elements of all baseband units. Within the channels which distribute the computing capacity of the computing elements of the baseband units of a baseband computer card (baseband board) for the baseband processing of a carrier, a certain equalisation between the channels within the baseband board can be assumed because of a statistical distribution of the quality of the received signals. Nevertheless it is possible that a baseband board that was originally designed for a specific carrier, can provide different baseband board computing capacity or itself requires additional computing capacity from other baseband boards.

According to a possible embodiment, a switching matrix is arranged on the one hand between the analogue processing sections of the base station (HF units) and the digital baseband processing units (baseband units) on the other hand. The switching matrix must be able to process the relatively high data rates which occur between a

transmitter/receiver device (transceiver) of an HF unit and a baseband unit that has spare computing capacity. For this the switching matrix has optical transmission means, for example.

However, to avoid switching the high data rates in the switching matrix, according to an advantageous development of the present invention it is proposed that the baseband processing be assigned to at least one specific computing element of at least one specific baseband unit, and that the baseband processing within the baseband unit be assigned, at least partially, to at least one further computing element of the baseband unit. According to this development, the baseband processing is thus assigned to several computing elements of the same baseband unit. The equalisation of the computing capacities therefore takes place between the computing elements of the same baseband unit.

According to another advantageous development of the present invention, it is proposed that the baseband processing be assigned to at least one specific computing element of at least one baseband unit, and that the baseband processing be assigned, at least partially, to a further computing element of at least one further baseband unit. According to this development, the computing capacity is therefore equalised between the computing elements of several baseband units of the same or different baseband boards.

According to a preferred embodiment of the present invention, it is proposed that the received signals be transmitted via several channels, one channel being assigned to each computing element, and that the baseband processing of a channel be assigned, at least partially, to a further computing element if the available computing

capacity of the at least one computing element assigned to the channel is inadequate. If a received signal with a relatively poor quality is transmitted via a specific channel and the available computing capacity of the computing element assigned to this channel is inadequate in order to process the received signal within a specified computing time and with a specified quality, at least one further computing element is employed for the baseband processing of the received signal transmitted via this channel. As a first option, the further computing element can participate in the baseband processing in addition to the original computing element or, as a second option, the further computing element can even take over the complete baseband processing from the original computing element. The second option is then conceivable, for example, if the full computing capacity of the further computing element is available, while the original computing element is partially occupied with the baseband processing of other channels of the received signal.

Advantageously, the expected available computing capacity of the at least one computing element assigned to the channel is estimated prior to the start of the baseband processing. Before the actual baseband processing is started, the expected available computing capacity can be determined by means of the total computing capacity of the at least one computing element and an expected utilisation. The expected utilisation of the at least one computing element can be estimated by means of the contents of the data of the received signal and by means of commands of a watchdog unit of the base station prior to the start of the baseband processing. If the expected available computing capacity of the at least one computing element is below a specified threshold value, to relieve the load, at least one further computing element is employed for the baseband processing or the entire baseband processing is switched to

the at least one further computing element.

Alternatively or additionally, it is proposed to monitor the utilisation of the at least one computing element assigned to the channel during the baseband processing. If it is shown that during the baseband processing the available computing capacity of the at least one computing element assigned to the channel falls below a specified threshold value, at least one further computing element is employed for the baseband processing, or the entire baseband processing is switched to the at least one further computing element.

As a further solution to the problem of the present invention, based on the base station of the type stated at the outset, it is proposed that the base station has first means for determining the utilisation of the computing elements of the baseband units and second means for assigning received signals waiting for baseband processing to at least one computing element of at least one baseband unit, the assignment being implemented according to the utilisation of the computing elements.

According to an advantageous development of the present invention it is proposed that the computing elements of the baseband units be interconnected via high-speed interfaces. The high-speed interfaces are constructed, for example, as so-called link ports which are designed for the connection of peripheral devices or other computing elements of the same type. The received signals waiting for baseband processing can be distributed among different computing elements via the connections between the individual computing elements. For example, the distribution of the received signals among the different computing elements can be co-ordinated by a watchdog unit, a co-processor or a direct memory access (DMA) machine, for example. In order

to distribute the received signals waiting for processing to the different computing elements, the data of the received signals are stored in the memory cells of the corresponding computing elements. The data are then retrieved from the computing elements for processing.

The embodiment with the connection of the computing elements via high-speed interfaces has the advantage over a switching matrix that said connection is substantially simpler and more economical to realise, since no complex, hardware-based fast switching of the high data rates is necessary between the HF units and the baseband units. By suitable preprocessing of the received signals in the computing elements of the baseband units, the data rates via the high-speed interfaces can be considerably reduced.

The second means for assigning the received signals to the at least one computing element are preferably constructed as a watchdog unit that passes the received signals waiting for baseband processing to a memory area of the at least one computing element.

Based on a radio telecommunications system of the type stated at the outset, as a further solution to the problem of the present invention, it is proposed that at least one of the base stations of the radio telecommunication system be constructed as a base station according to the invention.

Further features, possible applications of the invention are revealed in the following description of exemplary embodiments that are illustrated in the drawing. Here all described or illustrated features, either alone or in any combination, form the subject-matter of the invention,

irrespective of their combination in the patent claims or their cross-reference, and irrespective of their wording or representation in the description or in the drawing, respectively.

A radio telecommunications system, that is to say a universal mobile telecommunications system (UMTS) according to the invention, is shown in its entirety and denoted by the reference number 1 in Fig. 1. The radio telecommunications system 1 contains a number of mobile radio units MF, several base stations Node B, which are in radio contact with the mobile radio units MF, and at least one control device RNC (radio network controller), that is linked to the base stations Node B. In a so-called uplink mode, data from the mobile radio units MF are transmitted to the base stations Node B via the radio link. Data from various radio units MF are modulated according to the so-called code division multiple access (CDMA) method and transmitted via a common channel. Several channels are combined into one radio signal that is received as received signal 2 in those base stations Node B, with which the radio units MF are in radio contact. The received signals 2 are processed in the base stations Node B.

The processing of the received signals 2 (see Fig. 2) in the base stations Node B, is carried out separately for analogue and for digital signals. While the analogue

signals are processed in so-called high-frequency (HF) units 3, the digital signals are processed in so-called baseband units 4. Several HF units 3 are combined in an HF board 5 and several baseband units 4 are combined in a baseband board 6. Each of the HF units 3 and the baseband units 4 has a computing element 8, in particular a microprocessor, and a memory device 9 in which data to be processed can be stored. The data are transferred via a transmission line 10 from the memory device 9 to the computing element 8 for processing.

For signals 2 modulated according to the CDMA method, the digital processing in the baseband units 4 includes, among others, so-called symbol rate processing and so-called chip rate processing. Chip rate processing is employed for recovery of the individual channels from the received signals 2. Symbol rate processing is employed on an individual channel to recover the transmitted data of the individual radio units MF from the signal transmitted via the channel. The base stations Node B receive signals via different channels. According to the prior art, for the processing of the analogue and digital signals, a specified reference is provided in a base station between a channel and the HF units 3 or the baseband units 4, respectively, which process the signals of this channel. This rigid relationship is clearly shown by the link circuits 7 between each HF unit 3 and the respective baseband unit 4. The crux of the present invention is to replace the rigid assignment between HF units 3 and baseband units 4 known from the prior art, by a utilisation-related adaptive assignment. The computing capacity of the base stations Node B can thus be adapted to the actual requirements, particularly in modern radio telecommunications systems, such as UMTS telecommunications systems 1, for example. The actual, required computing capacity to process a received signal 2 within a specified time period with a specified

quality can in fact fluctuate widely, since it depends on the quality of the received signal 2. This particularly applies to chip rate processing as is used in a so-called rake receiver in the base stations Node B, for example. In a rake receiver, the computing effort, but also the quality of the signal, increases with the number of fingers.

In the base stations Node B according to the invention, the computing capacity of the baseband units 3 can therefore be reduced. For received signals 2 of conventional quality, the reduced computing capacity facilitates adequately fast and adequately good-quality processing. In the case of received signals 2 with a poorer quality, for which the provided computing capacity may not be adequate, the processing can be shared with several computing elements 8 of one or more baseband units 4 of one or more baseband boards 6, or assigned to one computing element 8 whose computing capacity is fully available.

The utilisation-dependent adaptive assignment of the received signals 2 to the computing elements 8 is facilitated so that the individual computing elements 8 of the baseband units 4 are interconnected via a high-speed interface 11. The high-speed interfaces 11 are constructed as so-called link ports which are designed for the connection of peripheral devices or other computing elements of the same type. The received signals 2 waiting for baseband processing can be distributed to different computing elements 8 of the baseband units 4 via the connections 12 between the individual computing elements 8. The distribution of the received signals 2 to the different computing elements 8 is co-ordinated by a watchdog unit, a co-processor or a direct memory access (DMA) machine, for example. In order to distribute the received signals 2 waiting for processing to the different computing elements 8, the data of the received signals 2 are stored in the

memory cells 13 of the corresponding computing elements 8, and from there are retrieved from the computing elements for processing.

A flowchart of the process according to the invention is illustrated in Fig. 3. The process starts in a function block 20. The utilisation of the computing elements 8 of the baseband units 4 is then determined in a function block 21. This can be a current utilisation or a utilisation that is expected in the future. The data waiting for baseband processing are then distributed in a function block 22 to one or more computing elements 8 depending on the utilisation of the computing elements 8. However, in the case of distribution to several computing elements 8, this must definitely not involve the same baseband unit 4 or the same baseband board 6. The data are then processed in a function block 23 by the computing elements 8 within a specified time period and with a specified quality. The process is completed in a function block 24.

4. Brief Description of Drawings

Figure 1 shows a radio telecommunications system according to the invention.

Figure 2 shows a base station according to the invention.

Figure 3 shows a flowchart of a process according to the invention.

Fig. 1

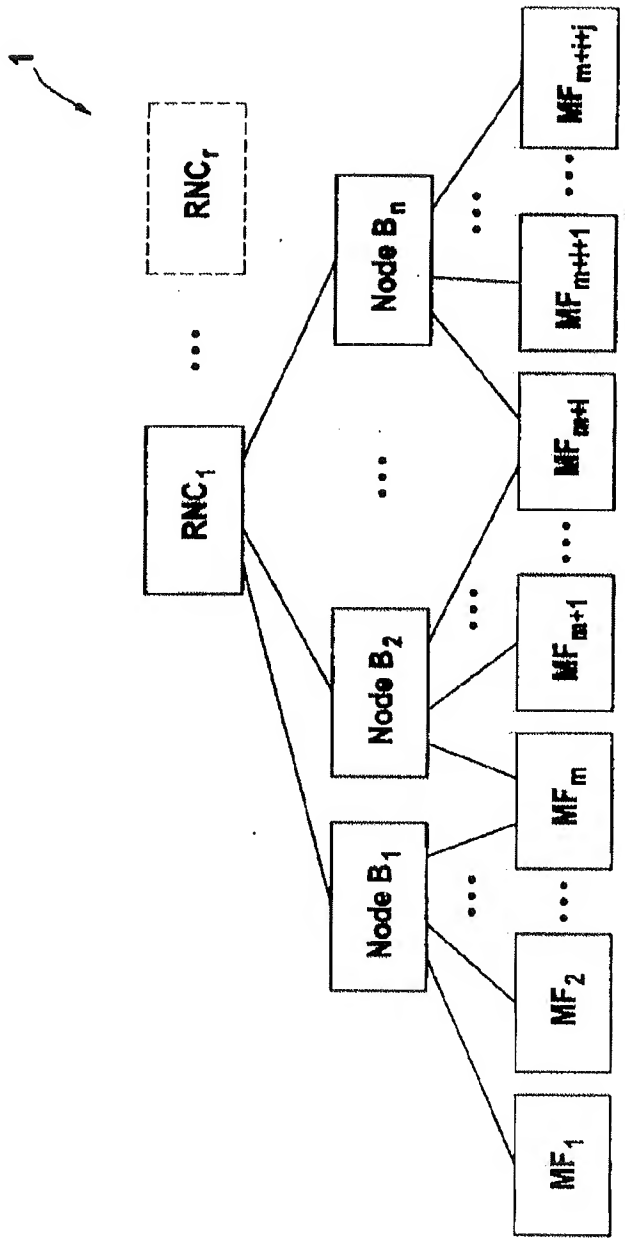

1
RNC$_r$
RNC$_1$
Node B$_n$
Node B$_2$
Node B$_1$
MF$_{m+i+j}$
MF$_{m+i+1}$
MF$_{m+1}$
MF$_{m+1}$
MF$_m$
MF$_2$
MF$_1$

Fig. 1

Fig. 2

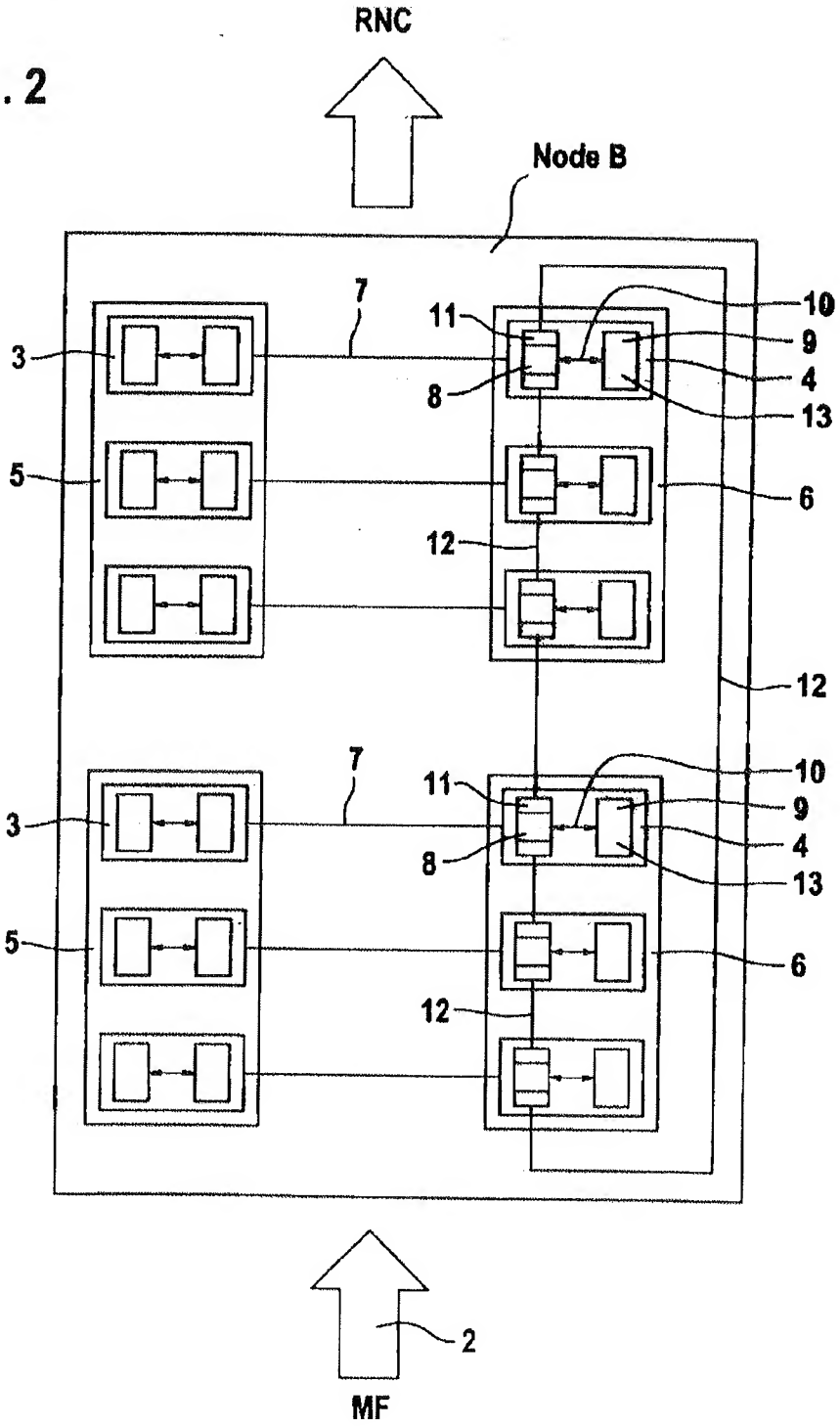


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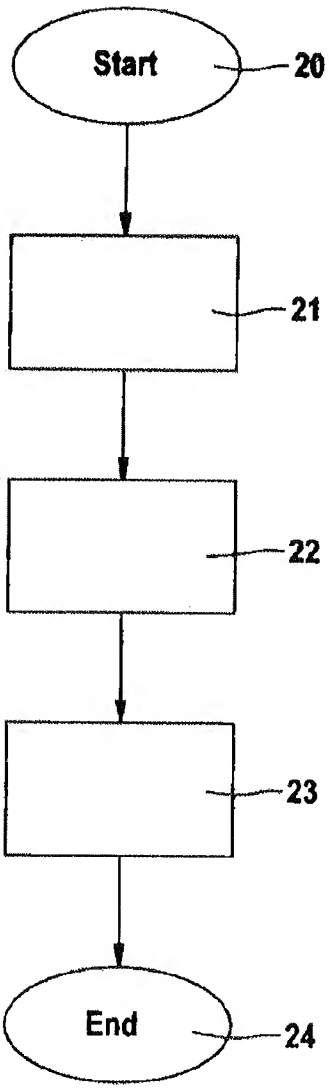
Fig. 3



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(54)【発明の名称】　受信信号のベースバンド処理のための方法および基地局

(57)【要約】
【課題】　無線遠隔通信システム１の基地局Ｎｏｄｅ Ｂの少なくとも１つのベースバンドユニット４における受信信号２のベースバンド処理のための方法であって、該ベースバンドユニット４またはすべてのベースバンドユニット４が、少なくとも１つの計算要素８、詳細には、マイクロプロセッサを有する方法を提供すること。
【解決手段】　基地局Ｎｏｄｅ　Ｂ内において、一方で、ハードウェアを無くすることができ、他方で、適切な計算処理能力が利用可能であり、したがって、劣悪な品質の受信信号２に関しても、規定の期間内に、規定の品質で処理されるのを確実にすることができるベースバンド処理を実施するため、ベースバンドユニット４の計算要素８の利用率に応じて、少なくとも１つのベースバンドユニット４の少なくとも１つの特定の計算要素８にベースバンド処理を割り当てることが提案される。

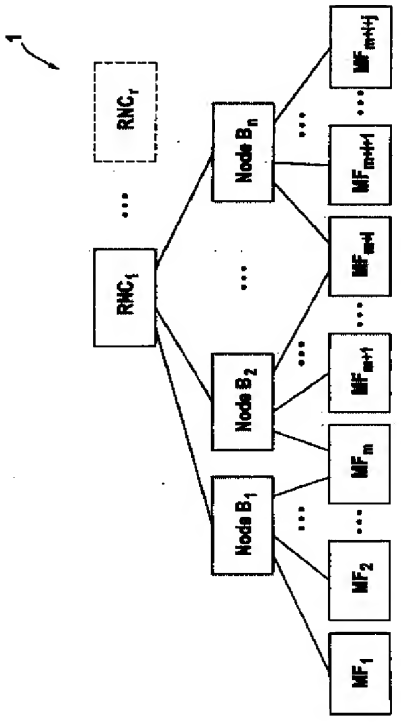

Fig. 1

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【特許請求の範囲】

【請求項１】　無線遠隔通信システムの基地局の少なくとも１つのベースバンドユニットにおける受信信号のベースバンド処理のための方法であって、該ベースバンドユニットまたはすべてのベースバンドユニットが、少なくとも１つの計算要素、特にマイクロプロセッサを有し、該ベースバンド処理が、該ベースバンドユニットの該計算要素の利用率に応じて、少なくとも１つのベースバンドユニットの少なくとも１つの特定の計算要素に割り当てられる方法。

【請求項２】　ベースバンド処理が、少なくとも１つの特定のベースバンドユニットの少なくとも１つの特定の計算要素に割り当てられ、かつ該ベースバンドユニット内の該ベースバンド処理が、該ベースバンドユニットの少なくともさらに１つの計算要素に、少なくとも部分的に割り当てられる請求項１に記載の方法。

【請求項３】　ベースバンド処理が、少なくとも１つの特定のベースバンドユニットの少なくとも１つの特定の計算要素に割り当てられ、かつ該ベースバンド処理が、少なくともさらに１つのベースバンドユニットの少なくとも１つの計算要素に、少なくとも部分的に割り当てられる請求項１に記載の方法。

【請求項４】　受信信号が、いくつかのチャネルを介して伝送され、少なくとも１つのチャネルが、各計算要素に割り当てられ、かつ該チャネルに割り当てられた該少なくとも１つの計算要素の利用可能な計算処理能力が不十分である場合、チャネルのベースバンド処理が、さらなる計算要素に少なくとも部分的に割り当てられる請求項１から３のいずれか一項に記載の方法。

【請求項５】　チャネルに割り当てられた少なくとも１つの計算要素の予期される利用率が、ベースバンド処理の開始に先立って推定される請求項４に記載の方法。

【請求項６】　チャネルに割り当てられた少なくとも１つの計算要素の利用率が、ベースバンド処理中に監視される請求項４または５に記載の方法。

【請求項７】　アナログ信号を処理するための少なくとも１つの高周波ユニット、およびデジタル信号を処理するためのいくつかのベースバンドユニットを含む、無線遠隔通信システムの基地局であって、該ベースバンドユニットのそれぞれが、少なくとも１つの計算要素、詳細には、マイクロプロセッサを有し、前記基地局は、該ベースバンドユニットの該計算要素の利用率を判定するための第１の手段と、ベースバンド処理を待つ受信信号を少なくとも１つのベースバンドユニットの少なくとも１つの計算要素に割り当てるための第２の手段とを有し、該割当ては、該計算要素の該利用率に応じて実施される基地局。

【請求項８】　ベースバンドユニットの前記計算要素が、高速インターフェースを介して相互接続される請求項７に記載の基地局。

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【請求項９】　前記第２の手段が、ベースバンド処理を待つ受信信号を少なくとも１つのベースバンドユニットの少なくとも１つの計算要素のメモリ領域に渡すウォッチドッグユニットとして設計される請求項７または８に記載の基地局。

【請求項１０】　いくつかのモバイル無線ユニットと、該モバイル無線ユニットと無線コンタクトしているいくつかの基地局と、該基地局にリンクされた、無線遠隔通信システムを制御するための少なくとも１つの制御デバイスとを含む無線遠隔通信システムであって、該基地局の前記少なくとも１つが、請求項７から９のいずれか一項に従って設計されたシステム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、無線遠隔通信システムの基地局の少なくとも１つのベースバンドユニットにおける受信信号のベースバンド処理のための方法に関する。ベースバンドユニットまたはすべてのベースバンドユニットは、少なくとも１つの計算要素、特にマイクロプロセッサを有する。

【０００２】本発明は、優先権主張の基礎出願ＤＥ　１０１　１５　６１０．３に基づき、該出願は、参照により、本明細書に組み込まれる。

【０００３】また、本発明は、アナログ信号を処理するための少なくとも１つの高周波（ＨＦ）ユニット、およびデジタル信号を処理するためのいくつかのベースバンドユニットを含む無線遠隔通信システムの基地局にも関する。ベースバンドユニットのそれぞれは、少なくとも１つの計算要素、詳細には、マイクロプロセッサを有する。

【０００４】最後に、本発明は、いくつかのモバイル無線ユニット、該モバイル無線ユニットと無線コンタクトしているいくつかの基地局、および該基地局にリンクされた、無線遠隔通信システムを制御するための少なくとも１つの制御デバイスを含む無線遠隔通信システムに関する。

【０００５】

【従来の技術】最初に述べたタイプの基地局を有する無線遠隔通信システムは、例えば、いわゆる汎用モバイル遠隔通信システム（ＵＭＴＳ）として従来技術で知られている。ＵＭＴＳ遠隔通信システムでは、基地局は、Ｎｏｄｅ　Ｂとして説明され、また制御デバイスは、無線ネットワークコントローラ（ＲＮＣ）として説明される。いわゆるアップリンクモードでは、データが、無線リンクを介してモバイル無線ユニットから基地局に伝送される。様々な無線ユニットからのデータは、いわゆる符号分割多重アクセス（ＣＤＭＡ）方法に従って変調され、共通チャネルを介して伝送される。いくつかのチャネルが、１つの無線信号に結合され、この信号が、無線ユニットが無線コンタクトしている基地局内で受信信号

として受信される。受信信号は、基地局内で処理される。

【０００６】基地局における受信信号の処理は、アナログ信号とデジタル信号に関して別々に行われる。アナログ信号は、いわゆる高周波（ＨＦ）ユニット内で処理されるが、デジタル信号は、いわゆるベースバンドユニット内で処理される。ＣＤＭＡ方法に従って変調される信号の場合、ベースバンドユニット内のデジタル処理には、とりわけ、いわゆる記号レート処理およびいわゆるチップレート処理が含まれる。チップレート処理は、受信信号から個々のチャネルを回復するのに使用される。記号レート処理は、チャネルを介して伝送された信号から個々の無線ユニットの伝送データを回復するため、個別のチャネルに対して使用される。

【０００７】基地局は、様々なチャネルを介して信号を受信する。従来技術によれば、アナログ信号およびデジタル信号の処理に関して、基地局で、それぞれ、チャネルと、該チャネルの信号を処理するＨＦユニットまたはベースバンドユニットの間で特定の基準が提供される。ただし、この特定の基準は、ベースバンド処理のために実質上一定の労力を必要とする。例えば、ＵＭＴＳ遠隔通信システムなどの、特に最新の無線遠隔通信システムでは、例えば、いわゆるレイク受信機（ｒａｋｅ　ｒｅｃｅｉｖｅｒ）で使用されるベースバンド処理労力、特にチップレート処理に関する労力は、一定ではなく、受信信号の品質に、つまり特定品質の信号の受信に必要なレイク受信機のフィンガ（ｆｉｎｇｅｒ）の数に依存する。したがって、チャネルの受信信号に関するベースバンド処理に必要な計算処理能力は、非常に幅広く異なる可能性がある。常に十分な計算処理能力を有するため、計算処理能力を比較的大きく設計して、最悪ケースであっても、受信信号が規定の時間内に規定の品質で処理されるのを確実にできるようにする必要がある。ただし、概して、この利用可能な計算処理能力の大部分は必要ではない、というのは受信信号の品質が、通常、最悪ケースよりも良好であるためである。

【０００８】

【発明が解決しようとする課題】したがって、本発明の目的は、無線遠隔通信システムの基地局において、一方で、該基地局内におけるハードウェアを無くすることができ、他方で、十分な計算処理能力が利用可能であり、したがって、劣悪な品質の受信信号に関しても、規定の期間内に、規定の品質で処理されるのを確実にすることができるベースバンド処理を実施することである。

【０００９】

【課題を解決するための手段】この目的を達するため、最初に述べたタイプの方法に基づき、ベースバンドユニットの計算要素の利用率に応じて、ベースバンド処理を少なくとも１つのベースバンドユニットの少なくとも１つの特定の計算要素に割り当てることが提案される。

【００１０】本発明によれば、したがって、まず、ベースバンドユニットの個々の計算要素の利用率を判定することが提案される。計算要素の利用率に応じて、次に、処理されるのを待っている受信信号のベースバンド処理が、少なくとも１つのベースバンドユニットの少なくとも１つの特定の計算要素に割り当てられる。本発明によれば、必要とされる利用可能な計算処理能力を有するベースバンドユニットの１つの計算要素に、ベースバンド処理全体を割り当てることが可能である。ただし、全体として、必要な計算処理能力を利用可能にすることができる１つまたは複数のベースバンドユニットのいくつかの計算要素でベースバンド処理を分担することも可能である。したがって、本発明の最重要点は、従来技術で知られているＨＦユニットとベースバンドユニットの間の固定された割当てを利用率に関連した適応割当て（ｕｔｉｌｉｓａｔｉｏｎ－ｒｅｌａｔｅｄ　ａｄａｐｔｉｖｅａｓｓｉｇｎｍｅｎｔ）で置き換えることである。

【００１１】基地局内で無くすることができるハードウェアが増えるほど、すべてのベースバンドユニットのすべての計算要素間でより一様にベースバンド処理を分散させることができる。搬送波のベースバンド処理のため、ベースバンドコンピュータカード（ベースバンドボード（ｂａｓｅｂａｎｄ　ｂｏａｒｄ））のベースバンドユニットの計算要素の計算処理能力を分配するチャネル内で、受信信号の品質の統計的分布のため、ベースバンドボード内のチャネル間のある等化を想定することができる。それでも、元は特定の搬送波に合わせて設計されているベースバンドボードが、異なるベースバンドボード計算処理能力を提供すること、またはそれ自体が、他のベースバンドボードから追加の計算処理能力を必要とすることが可能である。

【００１２】可能な実施形態によれば、一方では、基地局のアナログ処理セクション（ＨＦユニット）と、他方では、デジタルベースバンド処理ユニット（ベースバンドユニット）の間でスイッチングマトリックスが構成される。スイッチングマトリックスは、ＨＦユニットの送信機／受信機デバイス（トランシーバ）と、予備の計算処理能力を有するベースバンドユニットの間で生じる比較的高いデータ転送速度を処理できなければならない。このため、スイッチングマトリックスは、例えば、光伝送手段を有する。

【００１３】ただし、スイッチングマトリックスで高いデータ転送速度を交換するのを回避するため、本発明の有利な発展形態によれば、少なくとも１つの特定のベースバンドユニットの少なくとも１つの特定の計算要素にベースバンド処理を割り当てること、および該ベースバンドユニットの少なくともさらに１つの計算要素に、少なくとも部分的に、該ベースバンドユニット内のベースバンド処理を割り当てることが提案される。この発展形態によれば、ベースバンド処理は、したがって、同一の

ベースバンドユニットのいくつかの計算要素に割り当てられる。したがって、計算処理能力の等化は、同一のベースバンドユニットの計算要素間で行なわれる。

【００１４】本発明の別の有利な発展形態によれば、少なくとも１つのベースバンドユニットの少なくとも１つの特定の計算要素にベースバンド処理を割り当てること、および少なくともさらに１つのベースバンドユニットのさらなる計算要素に、少なくとも部分的に、ベースバンド処理を割り当てることが提案される。この発展形態によれば、計算処理能力は、したがって、同一のベースバンドボードまたは異なるベースバンドボードのいくつかのベースバンドユニットの計算要素間で等化される。

【００１５】本発明の好ましい実施形態によれば、１つのチャネルが各計算要素に割り当てられたいくつかのチャネルを介して受信信号を伝送すること、およびチャネルに割り当てられた少なくとも１つの計算要素の利用可能な計算処理能力が不十分である場合、さらなる計算要素に、少なくとも部分的に、該チャネルのベースバンド処理が割り当てられることが提案される。特定のチャネルを介して比較的劣悪な品質を有する受信信号が伝送され、かつ該チャネルに割り当てられた計算要素の利用可能な計算処理能力が、規定の計算時間内に規定の品質で該受信信号を処理するには不十分である場合、該チャネルを介して伝送された該受信信号のベースバンド処理のために、少なくともさらに１つの計算要素が使用される。第１のオプションとして、さらなる計算要素は、元の計算要素に加えてベースバンド処理に参加することができ、あるいは第２のオプションとして、さらなる計算要素は、元の計算要素からベースバンド処理全体を引き継ぐことさえできる。第２のオプションは、例えば、さらなる計算要素の完全な計算処理能力が利用可能であり、一方、元の計算要素が、受信信号の他のチャネルのベースバンド処理で部分的に占有されている場合、想定できる。

【００１６】有利には、チャネルに割り当てられた少なくとも１つの計算要素の予期される利用可能な計算処理能力は、ベースバンド処理の開始に先立って推定される。実際のベースバンド処理が開始される前に、少なくとも１つの計算要素の総計算処理能力および予期される利用率により、予期される利用可能な計算処理能力を判定することができる。少なくとも１つの計算要素の予期される利用率は、ベースバンド処理の開始に先立って、受信信号のデータの内容により、また基地局のウォッチドッグユニット（ｗａｔｃｈｄｏｇ　ｕｎｉｔ）のコマンドによって推定することができる。少なくとも１つの計算要素の予期される利用可能な計算処理能力が、規定のしきい値を下回る場合、負荷を軽減するため、少なくともさらに１つの計算要素が、ベースバンド処理のために使用されるか、あるいは該ベースバンド処理全体が、該少なくともさらに１つの計算要素に切り替えられる。

【００１７】別法では、またはさらには、ベースバンド処理中にチャネルに割り当てられた少なくとも１つの計算要素の利用率を監視することが提案される。ベースバンド処理中、チャネルに割り当てられた少なくとも１つの計算要素の利用可能な計算処理能力が、規定のしきい値を下回る場合、少なくともさらに１つの計算要素が、該ベースバンド処理のために使用されるか、あるいは該ベースバンド処理全体が、該少なくともさらに１つの計算要素に切り替えられる。

【００１８】本発明の問題に対するさらなる解決策として、最初に述べたタイプの基地局に基づき、基地局が、ベースバンドユニットの計算要素の利用率を判定するための第１の手段と、ベースバンド処理を待つ受信信号を少なくとも１つのベースバンドユニットの少なくとも１つの計算要素に割り当てるための第２の手段とを有し、割当ては、計算要素の利用率に応じて実施されることが提案される。

【００１９】本発明の有利な発展形態によれば、ベースバンドユニットの計算要素を高速インターフェースを介して相互接続することが提案される。高速インターフェースは、例えば、周辺デバイスまたは同じタイプの他の計算要素の接続に合わせて設計されたいわゆるリンクポートとして構成される。ベースバンド処理を待つ受信信号は、個々の計算要素間の接続を介して異なる計算要素間で分配することができる。例えば、異なる計算要素間における受信信号の分配を、例えば、ウォッチドッグユニット、コプロセッサ、または直接メモリアクセス（ＤＭＡ）マシンによって調整することが可能である。処理を待つ受信信号を異なる計算要素に分配するため、受信信号のデータは、対応する計算要素のメモリセル内に記憶される。次に、データは、処理のために計算要素から取り出される。

【００２０】高速インターフェースを介する計算要素の接続を有する実施形態は、前記接続を実装する方が相当に簡単であり、かつ経済的であるという、スイッチングマトリックスに優る利点を有する、というのは、ＨＦユニットとベースバンドユニットの間における高いデータ転送速度の複雑なハードウェアベースの高速スイッチングが、必要ないからである。ベースバンドユニットの計算要素で受信信号を適切に事前処理することにより、高速インターフェースを介するデータ転送速度を相当に低下させることができる。

【００２１】受信信号を少なくとも１つの計算要素に割り当てるための第２の手段は、好ましくは、ベースバンド処理を待つ受信信号を少なくとも１つの計算要素のメモリ領域に渡すウォッチドッグユニットとして構成される。

【００２２】最初に述べたタイプの無線遠隔通信システムに基づき、本発明の問題に対するさらなる解決策とし

て、無線遠隔通信システムの基地局の少なくとも１つを本発明による基地局として構成することが提案される。

【００２３】

【発明の実施の形態】本発明のさらなる特徴、可能な実施例を図面に示す例としての実施形態の以下の説明で明らかにする。あらゆる説明または図示する特徴は、単独またはあらゆる組合せで、それぞれ、特許請求項または相互参照における組合せに関わらず、また説明または図面における言回しまたは表現に関わらず、本発明の主題を構成する。

【００２４】無線遠隔通信システム、つまり本発明による汎用モバイル遠隔通信システム（ＵＭＴＳ）が全体として、参照番号１で表されて図１に示されている。無線遠隔通信システム１は、いくつかのモバイル無線ユニットＭＦと、該モバイル無線ユニットＭＦと無線コンタクトしているいくつかの基地局Ｎｏｄｅ　Ｂと、該基地局Ｎｏｄｅ　Ｂにリンクされた少なくとも１つの制御デバイスＲＮＣ（無線ネットワークコントローラ）とを含む。いわゆるアップリンクモードでは、モバイル無線ユニットＭＦからのデータが、無線リンクを介して基地局Ｎｏｄｅ　Ｂに伝送される。様々な無線ユニットＭＦからのデータが、いわゆる符号分割多重アクセス（ＣＤＭＡ）方法に従って変調され、共通チャネルを介して伝送される。いくつかのチャネルが１つの無線信号に結合され、この信号が、無線ユニットＭＦが無線コンタクトしている基地局Ｎｏｄｅ　Ｂで受信信号２として受信される。受信信号２は、基地局Ｎｏｄｅ　Ｂ内で処理される。

【００２５】基地局Ｎｏｄｅ　Ｂにおける受信信号２（図２参照）の処理は、アナログ信号とデジタル信号に関して別々に行われる。アナログ信号は、いわゆる高周波（ＨＦ）ユニット３内で処理されるが、デジタル信号は、いわゆるベースバンドユニット４で処理される。いくつかのＨＦユニット３が、ＨＦボード５で結合され、またいくつかのベースバンドユニット４が、ベースバンドボード６に結合されている。ＨＦユニット３およびベースバンドユニット４のそれぞれは、計算要素８、詳細には、マイクロプロセッサと、処理されるべきデータを記憶することができるメモリデバイス９とを有する。データは、処理のためにメモリデバイス９から計算要素８に伝送回線１０を介して転送される。

【００２６】ＣＤＭＡ方法に従って変調された信号２に関して、ベースバンドユニット４内のデジタル処理には、とりわけ、いわゆる記号レート処理およびいわゆるチップレート処理が含まれる。チップレート処理は、受信信号２から個々のチャネルを回復するのに使用される。記号レート処理は、チャネルを介して伝送された信号から個々の無線ユニットＭＦの伝送データを回復するため、個別のチャネルに対して使用される。基地局Ｎｏｄｅ　Ｂは、様々なチャネルを介して信号を受信する。従来技術によれば、アナログ信号およびデジタル信号の処理に関して、基地局で、それぞれ、チャネルと、該チャネルの信号を処理するＨＦユニット３またはベースバンドユニット４の間における特定の基準が提供される。この固定された関係が、各ＨＦユニット３と各ベースバンドユニット４の間のリンク回線７で明確に示されている。本発明の最重要点は、従来技術で知られているＨＦユニット３とベースバンドユニット４の間の固定された割当てを利用率に関連した適応割当てで置き換えることである。これにより、基地局Ｎｏｄｅ　Ｂの計算処理能力を実際の要件、詳細には、例えば、ＵＭＴＳ遠隔通信システム１などの最新の無線遠隔通信システムにおける要件に適合させることができる。規定の期間内に、規定の品質で受信信号２を処理するのに必要な実際の計算処理能力は、受信信号２の品質に依存するため、事実上大幅に変動する可能性がある。例えば、基地局Ｎｏｄｅ　Ｂのいわゆるレイク受信機で使用されるチップレート処理では特に上述のことが当てはまる。レイク受信機では、計算処理労力だけでなく、信号の品質もフィンガの数とともに高まる。

【００２７】本発明による基地局Ｎｏｄｅ　Ｂでは、したがって、ベースバンドユニット３の計算処理能力を低減することができる。従来品質の受信信号２に関して、より低い計算処理能力により、十分に高速で十分に良好な品質の処理が容易に行われる。提供される計算処理能力では十分でない可能性がある、劣悪な品質を有する受信信号２の場合、処理は、１つまたは複数のベースバンドボード６の１つまたは複数のベースバンドユニット４のいくつかの計算要素８で分担されること、あるいは、計算処理能力が完全に利用可能である１つの計算要素８に割り当てられることが可能である。

【００２８】計算要素８に対する受信信号２の利用率依存の適応割当ては、ベースバンドユニット４の個々の計算要素８が、高速インターフェース１１を介して相互接続されるように促進される。高速インターフェース１１は、周辺デバイスまたは同じタイプの他の計算要素の接続に合わせて設計されたいわゆるリンクポートとして構成される。ベースバンド処理を待つ受信信号２は、個々の計算要素８間の接続１２を介してベースバンドユニット４の異なる計算要素８に分配することができる。異なる計算要素８への受信信号２の分配は、例えば、ウォッチドッグユニット、コプロセッサ、または直接メモリアクセス（ＤＭＡ）マシンによって調整される。処理を待つ受信信号２を異なる計算要素８に分配するため、受信信号２のデータは、対応する計算要素８のメモリセル１３内に記憶され、そこから、処理のために計算要素から取り出される。

【００２９】本発明による処理の流れ図を図３に示している。処理は、機能ブロック２０で開始する。次に機能ブロック２１で、ベースバンドユニット４の計算要素８

9　　10

の利用率が判定される。これは、現行の利用率または将来に予期される利用率である。次に機能ブロック２２で、ベースバンド処理を待つデータが、計算要素８の利用率に応じて１つまたは複数の計算要素８に分配される。ただし、いくつかの計算要素８に分配される場合、この分配には、決して同一のベースバンドユニット４または同一のベースバンドボード６が関わるべきではない。次に機能ブロック２３で、データは、規定の期間内に規定の品質で計算要素８によって処理される。処理は、機能ブロック２４で完了する。

【図面の簡単な説明】

【図１】本発明による無線遠隔通信システムを示す図である。

【図２】本発明による基地局を示す図である。

【図３】本発明による方法を示す流れ図である。

【符号の説明】

＊１　無線遠隔通信システム
２　受信信号
３　高周波ユニット
４　ベースバンドユニット
５　高周波ボード
６　ベースバンドボード
７　リンク回線
８　計算要素
９　メモリデバイス
１０　伝送回線
１１　高速インターフェース
１２　接続
１３　メモリセル
Ｎｏｄｅ　Ｂ　基地局
ＭＦ　モバイル無線ユニット
＊　ＲＮＣ　無線ネットワークコントローラ

【図１】

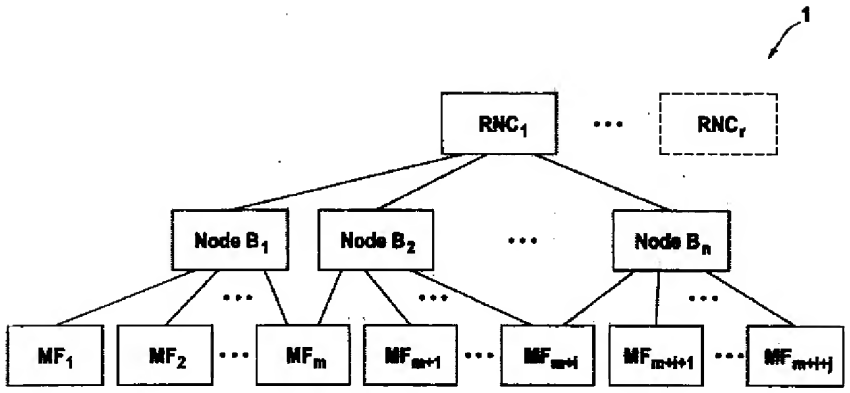


Fig. 1

【図３】

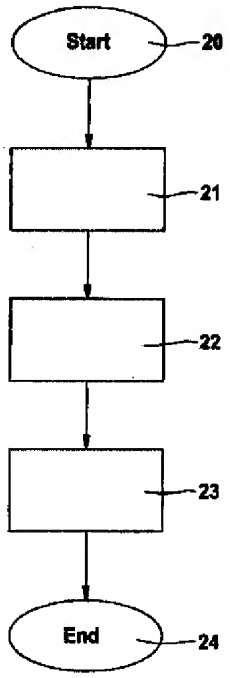
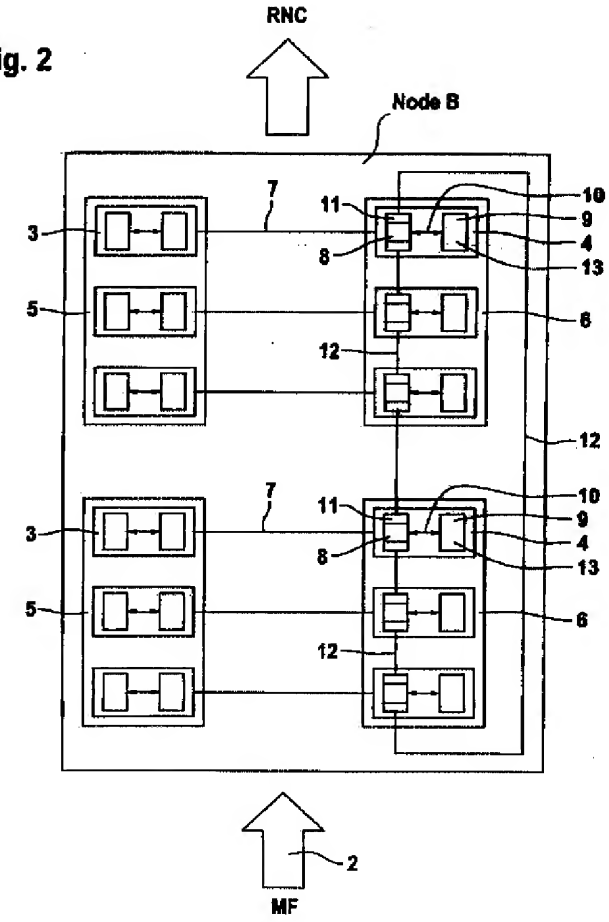


Fig. 3

【図２】

Fig. 2



【外国語明細書】

1. Title of Invention

Process and base station for baseband processing of received signals

2. Claims

1. Process for baseband processing of received signals in at least one baseband unit of a base station of a radio telecommunications system, wherein the baseband unit or every baseband unit has at least one computing element, in particular a microprocessor, wherein the baseband processing is assigned to at least one specific computing element of at least one baseband unit according to the utilisation of the computing elements of the baseband units.

2. Process according to Claim 1, wherein the baseband processing is assigned to at least one specific computing element of at least one specific baseband unit, and that the baseband processing within the baseband unit is assigned, at least partially, to at least one further computing element of the baseband unit.

3. Process according to Claim 1, wherein the baseband processing is assigned to at least one specific computing element of at least one specific baseband unit, and that the baseband processing is assigned, at least partially, to at least one computing element of at least one further baseband unit.

4. Process according to one of Claims 1 to 3, wherein the received signals are transmitted via several channels, wherein at least one channel is assigned to each computing element, and that the baseband processing of a channel is assigned, at least partially, to a further computing element, if the available computing capacity of the at least one computing element assigned to the channel is inadequate.

5. Process according to Claim 4, wherein the expected utilisation of the at least one computing element assigned to the channel is estimated prior to the start of the baseband processing.

6. Process according to Claim 4 or 5, wherein the utilisation of the at least one computing element assigned to the channel is monitored during the baseband processing.

7. Base station of a radio telecommunications system, containing at least one high-frequency unit for processing analogue signals and several baseband units for processing digital signals, wherein each of the baseband units has at least one computing element, in particular a microprocessor, said base station having first means for determining the utilisation of the computing elements of the baseband units and second means for assigning received signals waiting for baseband processing to at least one computing element of at least one baseband unit, wherein the assignment is implemented according to the utilisation of the computing elements.

8. Base station according to Claim 7, said the computing elements of the baseband units being interconnected via high-speed interfaces.

9. Base station according to Claim 7 or 8, said the second means being designed as a watchdog unit which pass the received signals waiting for baseband processing to a memory area of at least one computing element of at least one baseband unit.

10. Radio telecommunications system containing a number of mobile radio units, several base stations, that are in radio contact with the mobile radio units, and at least one control device for controlling the radio telecommunications system, which control device is linked to the base stations, said at least one of the base stations being designed according to one of Claims 7 to 9.

3. Detailed Description of Invention

Background of the invention

The present invention concerns a process for baseband processing of received signals in at least one baseband unit of a base station of a radio telecommunications system. The baseband unit or every baseband unit has at least one computing element, in particular a microprocessor.

The invention is based on a priority application DE 101 15 610.3 which is hereby incorporated by reference.

The invention also concerns a base station of a radio telecommunications system, containing at least one high-frequency (HF) unit for processing analogue signals and several baseband units for processing digital signals. Each of the baseband units has at least one computing element, in particular a microprocessor.

Finally, the present invention concerns a radio telecommunications system containing a number of mobile radio units, several base stations that are in radio contact with the mobile radio units, and at least one control device for controlling the radio telecommunications system, which is linked to the base stations.

Summary of the invention

A radio telecommunications system with base stations of the type stated at the outset is, for example, known from the prior art as a so-called universal mobile telecommunications system (UMTS). In UMTS

telecommunications systems, the base stations are described as Node B and the control devices as radio network controllers (RNC). In a so-called uplink mode, data are transmitted from the mobile radio units to the base station via a radio link. The data from various radio units are modulated according to the so-called code division multiple access (CDMA) process and transmitted via a common channel. Several channels are combined into one radio signal, which is received as a received signal in those base stations with which the radio units are in radio contact. The received signals are processed in the base stations.

The processing of the received signals in the base stations is carried out separately for analogue and for digital signals. While the analogue signals are processed in so-called high-frequency (HF) units, the digital signals are processed in so-called baseband units. In the case of signals modulated according to the CDMA process, the digital processing in the baseband units contains, among other things, so-called symbol rate processing and so-called chip rate processing. Chip rate processing is employed to recover the individual channels from the received signal. Symbol rate processing is employed on an individual channel in order to recover the transmitted data of the individual radio units from the signal transmitted via the channel.

The base stations receive signals via different channels. According to the prior art, for the processing of the analogue and digital signals, a specified reference is provided in a base station between a channel and the HF units or the baseband units, respectively, which process the signals of this channel. However, this specified reference requires a substantially constant effort for the baseband processing. In modern radio telecommunications systems in particular, such as for example UMTS

telecommunications systems, the baseband processing effort, in particular for chip rate processing, as used in a so-called rake receiver, for example, is not constant, but depends on the quality of the received signal, that is to say on the number of fingers of a rake receiver, that are required for the reception of a signal of a specific quality. The computing capacity required for the baseband processing for the received signals of a channel can therefore vary very widely. In order to always have sufficient computing capacity, it is necessary to design this to be relatively large to be able to ensure processing of the received signal within a specified time and with a specified quality, even in the worst case. On average, however, large parts of this available computing capacity are not needed since the quality of the received signal is usually better than the worst case.

The object of the present invention is therefore to realise, in base stations of radio telecommunications systems, baseband processing in which, on the one hand, hardware can be eliminated in the base station and, on the other hand, an adequate computing capacity is available so that, even for received signals of poor quality, processing can be ensured within a specified time period and with a specified quality.

To achieve this object, based on the process of the type stated at the outset, it is proposed that the baseband processing is assigned to at least one specific computing element of at least one baseband unit according to the utilisation of the computing elements of the baseband units.

According to the invention, it is therefore proposed to first determine the utilisation of the individual computing elements of the baseband units. Depending on the

utilisation of the computing elements, the baseband processing of a received signal waiting to be processed is then assigned to at least one specific computing element of at least one baseband unit. According to the present invention, it is possible to assign the entire baseband processing to one computing element of a baseband unit that has the required available computing capacity. However, it is also conceivable to share the baseband processing with several computing elements of one or more baseband units which, as a whole, can then make available the required computing capacity. The crux of the present invention is therefore to replace the rigid assignment between HF units and baseband units known from the prior art, by a utilisation-related adaptive assignment.

The more hardware that can be eliminated in a base station, then the more uniformly the baseband processing can be distributed among all computing elements of all baseband units. Within the channels which distribute the computing capacity of the computing elements of the baseband units of a baseband computer card (baseband board) for the baseband processing of a carrier, a certain equalisation between the channels within the baseband board can be assumed because of a statistical distribution of the quality of the received signals. Nevertheless it is possible that a baseband board that was originally designed for a specific carrier, can provide different baseband board computing capacity or itself requires additional computing capacity from other baseband boards.

According to a possible embodiment, a switching matrix is arranged on the one hand between the analogue processing sections of the base station (HF units) and the digital baseband processing units (baseband units) on the other hand. The switching matrix must be able to process the relatively high data rates which occur between a

transmitter/receiver device (transceiver) of an HF unit and a baseband unit that has spare computing capacity. For this the switching matrix has optical transmission means, for example.

However, to avoid switching the high data rates in the switching matrix, according to an advantageous development of the present invention it is proposed that the baseband processing be assigned to at least one specific computing element of at least one specific baseband unit, and that the baseband processing within the baseband unit be assigned, at least partially, to at least one further computing element of the baseband unit. According to this development, the baseband processing is thus assigned to several computing elements of the same baseband unit. The equalisation of the computing capacities therefore takes place between the computing elements of the same baseband unit.

According to another advantageous development of the present invention, it is proposed that the baseband processing be assigned to at least one specific computing element of at least one baseband unit, and that the baseband processing be assigned, at least partially, to a further computing element of at least one further baseband unit. According to this development, the computing capacity is therefore equalised between the computing elements of several baseband units of the same or different baseband boards.

According to a preferred embodiment of the present invention, it is proposed that the received signals be transmitted via several channels, one channel being assigned to each computing element, and that the baseband processing of a channel be assigned, at least partially, to a further computing element if the available computing

capacity of the at least one computing element assigned to the channel is inadequate. If a received signal with a relatively poor quality is transmitted via a specific channel and the available computing capacity of the computing element assigned to this channel is inadequate in order to process the received signal within a specified computing time and with a specified quality, at least one further computing element is employed for the baseband processing of the received signal transmitted via this channel. As a first option, the further computing element can participate in the baseband processing in addition to the original computing element or, as a second option, the further computing element can even take over the complete baseband processing from the original computing element. The second option is then conceivable, for example, if the full computing capacity of the further computing element is available, while the original computing element is partially occupied with the baseband processing of other channels of the received signal.

Advantageously, the expected available computing capacity of the at least one computing element assigned to the channel is estimated prior to the start of the baseband processing. Before the actual baseband processing is started, the expected available computing capacity can be determined by means of the total computing capacity of the at least one computing element and an expected utilisation. The expected utilisation of the at least one computing element can be estimated by means of the contents of the data of the received signal and by means of commands of a watchdog unit of the base station prior to the start of the baseband processing. If the expected available computing capacity of the at least one computing element is below a specified threshold value, to relieve the load, at least one further computing element is employed for the baseband processing or the entire baseband processing is switched to

the at least one further computing element.

Alternatively or additionally, it is proposed to monitor the utilisation of the at least one computing element assigned to the channel during the baseband processing. If it is shown that during the baseband processing the available computing capacity of the at least one computing element assigned to the channel falls below a specified threshold value, at least one further computing element is employed for the baseband processing, or the entire baseband processing is switched to the at least one further computing element.

As a further solution to the problem of the present invention, based on the base station of the type stated at the outset, it is proposed that the base station has first means for determining the utilisation of the computing elements of the baseband units and second means for assigning received signals waiting for baseband processing to at least one computing element of at least one baseband unit, the assignment being implemented according to the utilisation of the computing elements.

According to an advantageous development of the present invention it is proposed that the computing elements of the baseband units be interconnected via high-speed interfaces. The high-speed interfaces are constructed, for example, as so-called link ports which are designed for the connection of peripheral devices or other computing elements of the same type. The received signals waiting for baseband processing can be distributed among different computing elements via the connections between the individual computing elements. For example, the distribution of the received signals among the different computing elements can be co-ordinated by a watchdog unit, a co-processor or a direct memory access (DMA) machine, for example. In order

to distribute the received signals waiting for processing to the different computing elements, the data of the received signals are stored in the memory cells of the corresponding computing elements. The data are then retrieved from the computing elements for processing.

The embodiment with the connection of the computing elements via high-speed interfaces has the advantage over a switching matrix that said connection is substantially simpler and more economical to realise, since no complex, hardware-based fast switching of the high data rates is necessary between the HF units and the baseband units. By suitable preprocessing of the received signals in the computing elements of the baseband units, the data rates via the high-speed interfaces can be considerably reduced.

The second means for assigning the received signals to the at least one computing element are preferably constructed as a watchdog unit that passes the received signals waiting for baseband processing to a memory area of the at least one computing element.

Based on a radio telecommunications system of the type stated at the outset, as a further solution to the problem of the present invention, it is proposed that at least one of the base stations of the radio telecommunication system be constructed as a base station according to the invention.

Further features, possible applications of the invention are revealed in the following description of exemplary embodiments that are illustrated in the drawing. Here all described or illustrated features, either alone or in any combination, form the subject-matter of the invention,

irrespective of their combination in the patent claims or their cross-reference, and irrespective of their wording or representation in the description or in the drawing, respectively.

A radio telecommunications system, that is to say a universal mobile telecommunications system (UMTS) according to the invention, is shown in its entirety and denoted by the reference number 1 in Fig. 1. The radio telecommunications system 1 contains a number of mobile radio units MF, several base stations Node B, which are in radio contact with the mobile radio units MF, and at least one control device RNC (radio network controller), that is linked to the base stations Node B. In a so-called uplink mode, data from the mobile radio units MF are transmitted to the base stations Node B via the radio link. Data from various radio units MF are modulated according to the so-called code division multiple access (CDMA) method and transmitted via a common channel. Several channels are combined into one radio signal that is received as received signal 2 in those base stations Node B, with which the radio units MF are in radio contact. The received signals 2 are processed in the base stations Node B.

The processing of the received signals 2 (see Fig. 2) in the base stations Node B, is carried out separately for analogue and for digital signals. While the analogue

signals are processed in so-called high-frequency (HF) units 3, the digital signals are processed in so-called baseband units 4. Several HF units 3 are combined in an HF board 5 and several baseband units 4 are combined in a baseband board 6. Each of the HF units 3 and the baseband units 4 has a computing element 8, in particular a microprocessor, and a memory device 9 in which data to be processed can be stored. The data are transferred via a transmission line 10 from the memory device 9 to the computing element 8 for processing.

For signals 2 modulated according to the CDMA method, the digital processing in the baseband units 4 includes, among others, so-called symbol rate processing and so-called chip rate processing. Chip rate processing is employed for recovery of the individual channels from the received signals 2. Symbol rate processing is employed on an individual channel to recover the transmitted data of the individual radio units MF from the signal transmitted via the channel. The base stations Node B receive signals via different channels. According to the prior art, for the processing of the analogue and digital signals, a specified reference is provided in a base station between a channel and the HF units 3 or the baseband units 4, respectively, which process the signals of this channel. This rigid relationship is clearly shown by the link circuits 7 between each HF unit 3 and the respective baseband unit 4. The crux of the present invention is to replace the rigid assignment between HF units 3 and baseband units 4 known from the prior art, by a utilisation-related adaptive assignment. The computing capacity of the base stations Node B can thus be adapted to the actual requirements, particularly in modern radio telecommunications systems, such as UMTS telecommunications systems 1, for example. The actual, required computing capacity to process a received signal 2 within a specified time period with a specified

quality can in fact fluctuate widely, since it depends on the quality of the received signal 2. This particularly applies to chip rate processing as is used in a so-called rake receiver in the base stations Node B, for example. In a rake receiver, the computing effort, but also the quality of the signal, increases with the number of fingers.

In the base stations Node B according to the invention, the computing capacity of the baseband units 3 can therefore be reduced. For received signals 2 of conventional quality, the reduced computing capacity facilitates adequately fast and adequately good-quality processing. In the case of received signals 2 with a poorer quality, for which the provided computing capacity may not be adequate, the processing can be shared with several computing elements 8 of one or more baseband units 4 of one or more baseband boards 6, or assigned to one computing element 8 whose computing capacity is fully available.

The utilisation-dependent adaptive assignment of the received signals 2 to the computing elements 8 is facilitated so that the individual computing elements 8 of the baseband units 4 are interconnected via a high-speed interface 11. The high-speed interfaces 11 are constructed as so-called link ports which are designed for the connection of peripheral devices or other computing elements of the same type. The received signals 2 waiting for baseband processing can be distributed to different computing elements 8 of the baseband units 4 via the connections 12 between the individual computing elements 8. The distribution of the received signals 2 to the different computing elements 8 is co-ordinated by a watchdog unit, a co-processor or a direct memory access (DMA) machine, for example. In order to distribute the received signals 2 waiting for processing to the different computing elements 8, the data of the received signals 2 are stored in the

memory cells 13 of the corresponding computing elements 8, and from there are retrieved from the computing elements for processing.

A flowchart of the process according to the invention is illustrated in Fig. 3. The process starts in a function block 20. The utilisation of the computing elements 8 of the baseband units 4 is then determined in a function block 21. This can be a current utilisation or a utilisation that is expected in the future. The data waiting for baseband processing are then distributed in a function block 22 to one or more computing elements 8 depending on the utilisation of the computing elements 8. However, in the case of distribution to several computing elements 8, this must definitely not involve the same baseband unit 4 or the same baseband board 6. The data are then processed in a function block 23 by the computing elements 8 within a specified time period and with a specified quality. The process is completed in a function block 24.

4. Brief Description of Drawings

Figure 1 shows a radio telecommunications system according to the invention.

Figure 2 shows a base station according to the invention.

Figure 3 shows a flowchart of a process according to the invention.

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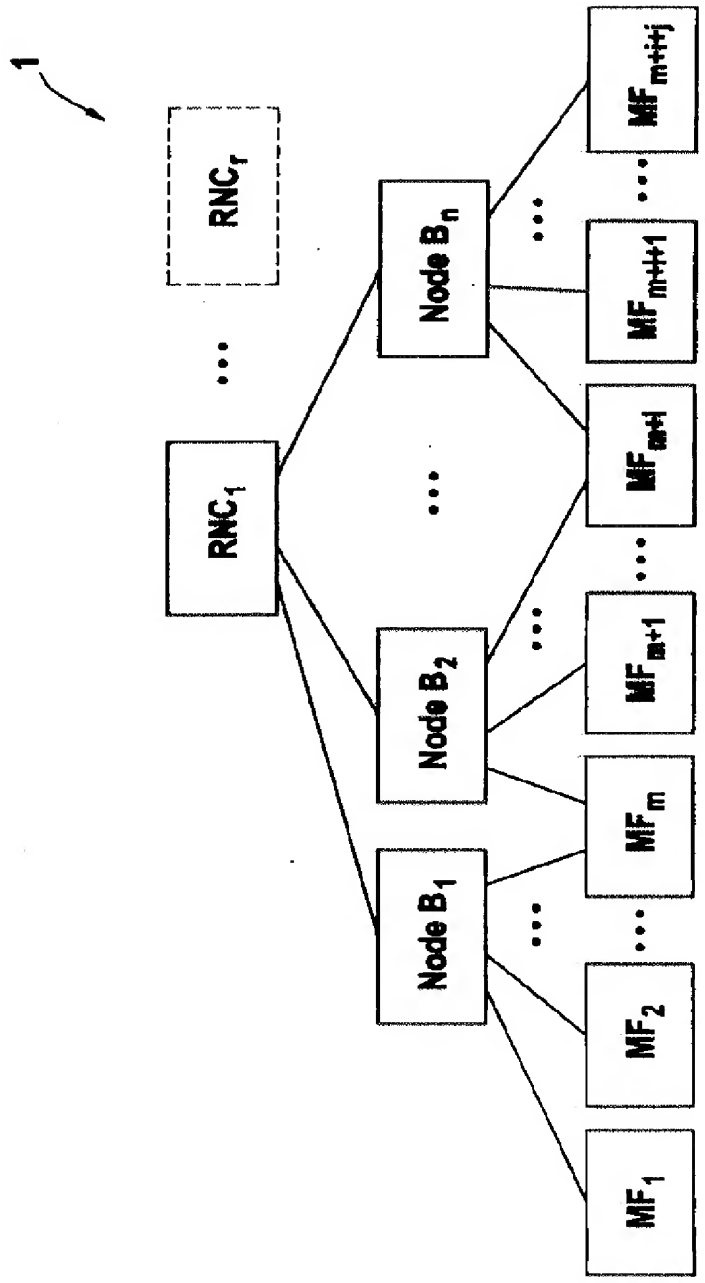
1
RNC$_r$
RNC$_1$
Node B$_n$
Node B$_2$
Node B$_1$
MF$_{m+i+j}$
MF$_{m+i+1}$
MF$_{m+1}$
MF$_{m+1}$
MF$_m$
MF$_2$
MF$_1$

Fig. 1

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Fig. 2

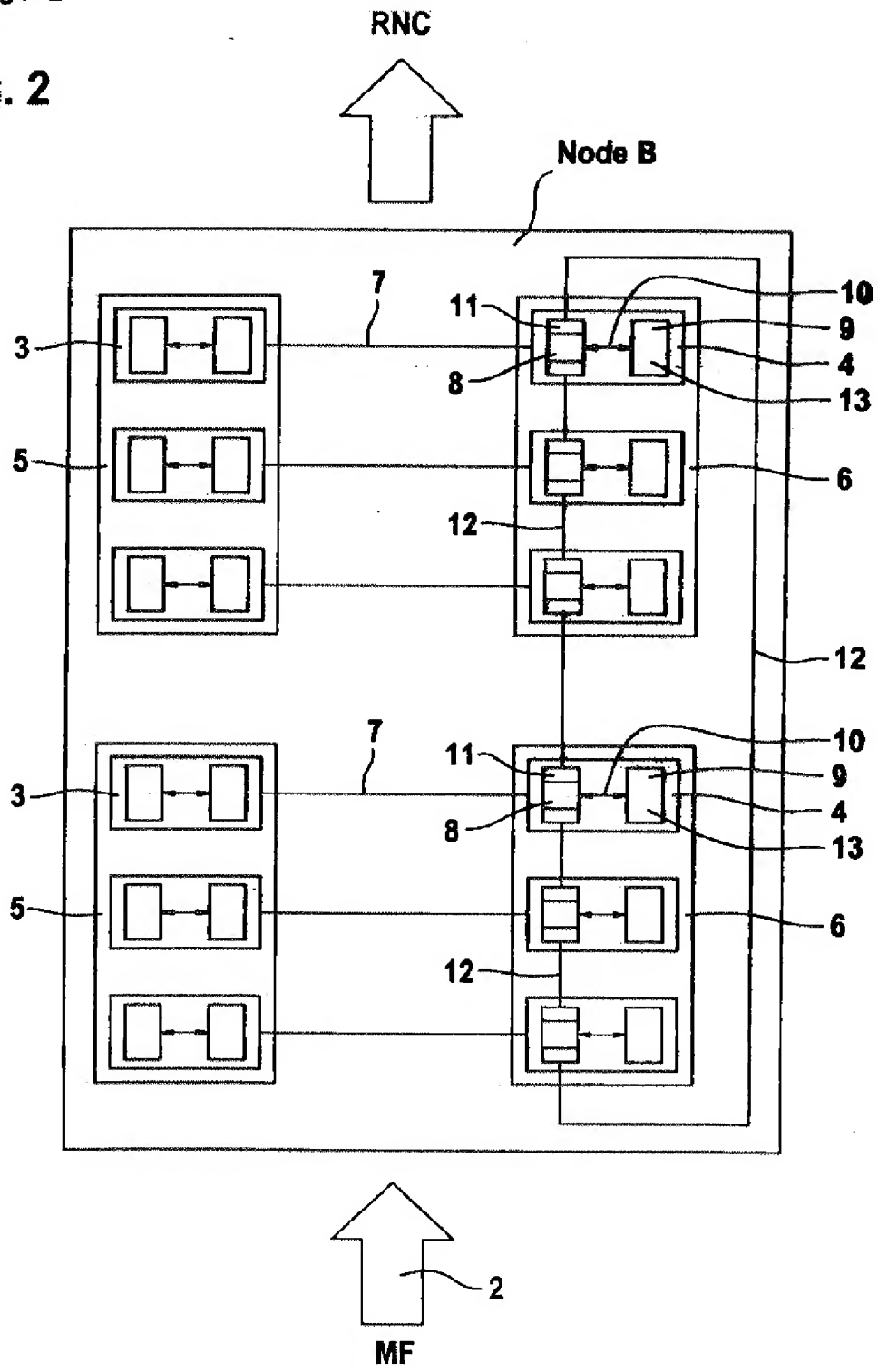

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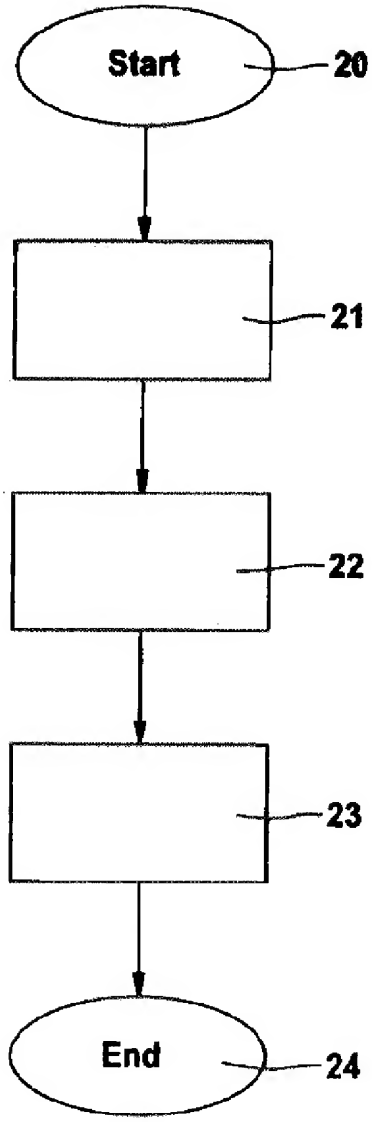
Fig. 3



1. Abstract

The invention concerns a process for baseband processing of received signals (2) in at least one baseband unit (4) of a base station (Node B) of a radio telecommunications system (1), wherein the baseband unit (4) or every baseband unit (4) has at least one computing element (8), in particular a microprocessor. In order to realise baseband processing in the base station (Node B), in which, on the one hand, hardware can be eliminated and, on the other hand, an adequate computing capacity is available so that, even for received signals (2) of poor quality, processing can be ensured within a specified time period and with a specified quality, it is proposed that the baseband processing is assigned to at least one specific computing element (8) of at least one baseband unit (4) according to the utilisation of the computing elements (8) of the baseband units (4).

2. Representative Drawing

Fig. 1